

Authors

Ju-Mee Ryoo

Oak Ridge Associated Universities Inc.
NASA Ames Research Center

Matthew S Johnson

NASA Ames Research Center

Laura T Iraci

NASA Ames Research Center

Emma L Yates

NASA Ames Research Center

R. Bradley Pierce

NOAA/NESDIS

Tomoaki Tanaka

NASA Ames Research Center

Warren Gore

NASA Ames Research Center

NF1676B TN29592

Investigation of ozone sources in California using AJAX airborne measurements and models: Implications for stratospheric intrusion and long range transport

High ozone concentrations at low altitudes near the surface were detected from airborne Alpha Jet Atmospheric eXperiment (AJAX) measurements on May 30, 2012. We investigate the causes of the elevated ozone concentrations using the airborne measurements and various models. GEOS-chem and WRF-STILT model simulations show that the contribution from local sources is small. From MERRA reanalysis, it is found that high potential vorticity (PV) is observed at low altitudes. This high PV appears to be only partially coming through the stratospheric intrusions because the air inside the high PV region is moist, which shows that mixing appears to be enhanced in the low altitudes. Considering that diabatic heating can also produce high PV in the lower troposphere, high ozone is partially coming through stratospheric intrusion, but this cannot explain the whole ozone concentration in the target areas of the western U.S.

A back-trajectory model is utilized to see where the air masses originated. The air masses of the target areas came from the lower stratosphere (LS), upper (UT), mid- (MT), and lower troposphere (LT). The relative number of trajectories coming from LS and UT is low (7.7% and 7.6%, respectively) compared to that from LT (64.1%), but the relative ozone concentration coming from LS and UT is high (38.4% and 20.95%, respectively) compared to that from LT (17.7%). The air mass coming from LT appears to be mostly coming from Asia. Q diagnostics show that there is sufficient mixing along the trajectory to indicate that ozone from the different origins is mixed and transported to the western U.S.

This study shows that high ozone concentrations can be detected by airborne measurements, which can be analyzed by integrated platforms such as models, reanalysis, and satellite data.